

*Protector del Agua*

# Residential Irrigation Systems



**MWD**

*METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA*

# ACKNOWLEDGEMENTS

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Originally developed for  
Metropolitan Water District of Southern California

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Updated material provided by WaterWise Consulting



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# THE IRRIGATION SYSTEM

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## THE CONTROLLED LEAK



***Know your irrigation system***

Hand watering is one of the best methods of providing the plants in your garden with the water they need. Unfortunately, hand watering is the most time consuming and labor intensive method of watering. For that reason, we have turned to the irrigation system to satisfy the water needs of our gardens.

A well installed and maintained irrigation system can be efficient and give your garden many years of service. Remember, that the success of your garden largely depends on your understanding of the basic functions of the irrigation system.

Think of the irrigation system as being a *controlled leak*. The *leak* is controlled by various components, which include the pipe, valves, sprinklers, and the irrigation controller. You will learn more about these irrigation components in the following pages. The person programming the controller also controls this leak. This is done by selecting the water times and watering days. This booklet will also provide some tips about scheduling your irrigation system.

***The goal is to best control that leak for the benefit of your garden.***

In other words, learn more about the irrigation system to improve the management of it. If you are about to install a new system, and the area of landscape that you're working with is extensive and in need of a complex irrigation system, consider hiring a professional landscaper. After reviewing the basics of the irrigation system in this booklet, you should have better success in hiring the right person by asking the right questions. This booklet will also expose you to terminology that will allow you to better communicate with your landscaper or contractor.

## Benefits of a Good Irrigation System

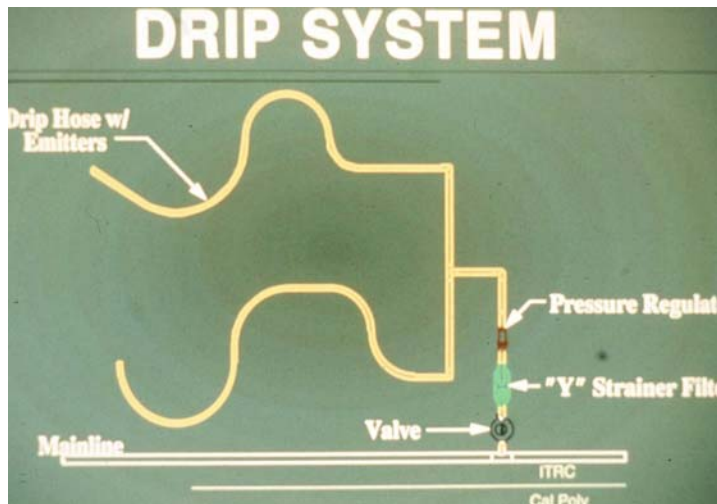
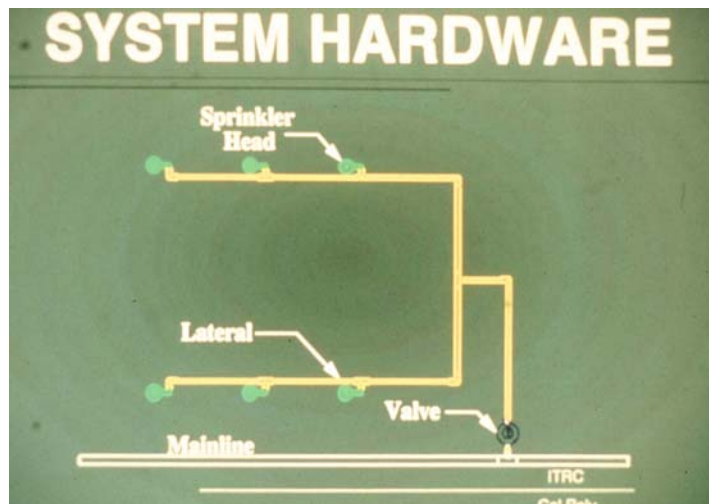
In addition to the description of the system components, this booklet will discuss the common problems affecting the performance of the system. If you eliminate those problems, improve the performance of the sprinkler system and adjust your watering schedule, you will see some of the benefits listed below:

- Improved aesthetics of your landscape (eliminating dry spots)
- Healthier plant material
- Reduced water use and water costs (efficient irrigation results in less water use)
- Reduced use of chemicals (disease and pest problems arise with improper watering)
- Reduced run-off (water does not stay in the landscape and runs-off)

# THE LAYOUT OF THE SYSTEM

In most cases, water used for the landscape comes from the same line supplying water for indoor use. This line or pipe is called the *main line*. Similar to a water fixture inside the home, the irrigation valves are also connected to the same main line. This connection or *take-off* of the system is often found near a hose bib. It is important to note that a main line is always pressurized; there's always water available (as long as the water meter is on).

Below are two graphics of system hardware to describe the layout of sprinkler and drip systems. The components will be described more in the following pages.





# IRRIGATION SYSTEM COMPONENTS

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There are two types of irrigation systems. One type of system applies the water over an area of landscape—**overhead irrigation system**. An overhead system is used to water a lawn or a groundcover area. In an overhead system the water is not applied directly to the root-zone of the plant material, but rather, falls onto the plants similar to rain.

The second type of system applies the water directly to the root zone—**drip or bubbler system**. This type of system is commonly used on shrubs, trees, palms and narrow planter beds. Both the drip and the bubbler type provide the water directly to the root zone. The rate of application for both the drip and bubbler is very different. Both types of systems are commonly used in landscapes and both can be efficient if installed and maintained correctly. The following pages will provide a detailed description of components that relate to the irrigation system.



*Your water meter*

## The Water Meter

This device is commonly found in the front of your property, measures the amount of water that is used indoors and outdoors. This is a great tool for managing the amount of water that is used. If you keep track of water use, you are bound to use water more efficiently.

The water meter measures in hundred cubic feet (hcf). Every number change is equal to 1hcf (100 cubic feet). **1hcf is equal to about 750 gallons.** At home we use thousands of gallons each month, and in most cases, the larger portion of that water use is dedicated to watering the garden.

## Shut-off Ball Valve

It is important to install a shut-off before any irrigation system control valve. Having this shut-off valve isolates the irrigation system and allows you to turn off the water to the system, but still have water for indoor use. Although you'll enjoy your irrigation system for many years, it will need to be maintained or repaired throughout its life. For that reason it is a good idea to separate or isolate the irrigation system using a shut-off valve. A brass ball valve, similar to the one shown, works great as a shut-off or isolation valve. A PVC ball valve may also be used.



*Brass ball valves and PVC ball valve*

# OVERHEAD IRRIGATION

## Backflow Prevention

It is important to note that every irrigation system installed must comply with local codes and provide proper prevention of water backflow. In addition to obtaining installation permits, check your local codes for details on backflow prevention. Generally, there are two ways to prevent water that is inside your irrigation pipes from returning or flowing back to the source due to suction in the pipes. One way is to install a component called a **backflow preventer**. The other method is to simply use **anti-siphon** type irrigation valves. For more information on the backflow preventer device and the installation please inquire at your local home improvement center.



*Anti-Siphon Valves for Irrigation*

## Anti-Siphon Irrigation Valves

Anti-siphon type valves are the most common for residential irrigation systems. Each valve turns on/off the water to an area in your garden, while providing backflow prevention at the same time. Each of the four valves shown irrigates a different area of the garden. Most installation codes require that this valve be installed at least 12 inches above the highest sprinkler head. In the case of a hill, the valve may be installed on the top of the hill with the lateral running down from it. An alternative is to install an atmospheric vacuum breaker on the top of the hill, after the valve, but before any sprinklers. It is also a good idea to leave an extra outlet for future installations as demonstrated in the picture.



*Outdoor Controller for Irrigation*

## Irrigation Controller

There's a vast array of irrigation controllers, but the basic functions are the same for all makes and models. All irrigation controllers have the capability of turning on certain days, at a certain time, and for a given duration or runtime. Basically, there are two types: indoor and outdoor controllers. Outdoor controllers, like the one shown, typically have sturdier, larger boxes. Indoor controllers, which you can easily plug into a receptacle, may offer the same capabilities, but eliminate the large encasing.

Features to look for in a new controller include: multiple programs ABC, multiple runtimes, water budget, and station test.

If you hire someone to maintain your garden and irrigation system, it may be better to install an outdoor controller for their convenience. Controllers range in number of stations available or number of valves that may be connected to it. The more stations you have, the higher the cost. A good way to estimate the cost of a controller is to estimate each station at a cost of \$10 to \$15 dollars.

# OVERHEAD IRRIGATION

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*Gear-Driven Rotor Sprinkler*

## **Rotor Sprinkler—Gear Driven**

Rotors are used to irrigate a large turf or groundcover area. Their radius or distance of throw is anywhere from 25 feet to 60 feet. Instead of using many short radius sprayheads, use a few rotors to take their place and cover the area with superior uniformity. Pop-up height is about 4 inches. Gear-driven rotors apply the water at a slow application rate. For that reason, we typically have longer runtimes for this type of system. Rotors have a variety of interchangeable nozzles that control the amount of water coming out and the distance that they throw.



*Impact Rotor Sprinkler*

## **Impact Rotor Sprinkler**

Impact rotor sprinklers are also used in large turf and groundcover areas. Their radius of throw and application rate is similar to the gear-driven rotors. They also have interchangeable nozzles.

It is the impact of the spoon on the sprinkler that makes it rotate, hence the name—impact rotor. Due to their durability (brass) and simple workings (no gears), impact rotors are commonly used in groundcover areas where sprinklers often need to be exposed. Both pop-up and non-pop-up models are available.



*Sprayhead Sprinkler*

## **Sprayhead Sprinkler**

Sprayheads are used on small turf, groundcover, or planting areas. Their radius of throw ranges from four feet to 15 feet. The application rate is quite high; therefore, we provide a shorter runtime or minutes of irrigation.

Sprayheads also have interchangeable nozzles depending on the area to be watered. The nozzle controls the arc or area being watered. A sprayhead in the middle of a lawn area, for example, will need an arc of 360 degrees compared to one next to a sidewalk, which would only need 180 degrees. There are many configurations of nozzles available, even some that offer a low angle trajectory for windy areas.



# OVERHEAD IRRIGATION

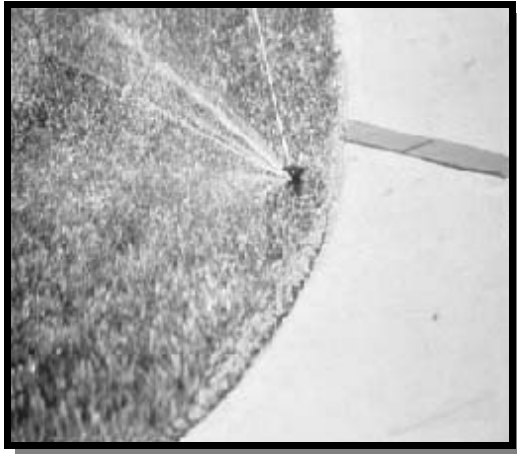
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***Shrub Sprayhead***

## **Shrub Sprayhead**

The shrub sprayhead is simply a spray nozzle connected to an adapter, which is then screwed onto the tip of an elevated riser. The range in radius and the application rate is parallel to the regular sprayhead sprinkler, with short radius and high precipitation. This type of irrigation is helpful in areas where plant interference may be a problem. The nozzle may be elevated several feet above the ground. See picture on top left.



***Stream Rotor Sprinkler***

## **Stream Rotor**

The stream rotor sprinkler offers a radius between 20 and 35 feet. It applies water at a slow rate, similar to the gear rotor. This sprinkler is also very quiet when operating. It offers a multiple stream pattern, with each stream covering a different part of the radius. It is also pop-up capable.

Due to its low application rate, the stream rotor is often used on slopes, where erosion and run-off is frequently a problem.

# DIRECT ROOT ZONE IRRIGATION

For watering trees, shrubs, palms and narrow planter beds directly at the base we go from overhead irrigation to a more efficient method—**root zone irrigation**. This method includes a high-flow type of irrigation system (bubblers) and a low-flow irrigation system (drip).



**Bubbler System**

*Some bubblers offer a specified flow; others may be adjusted to fit the water needs of the different materials.*

## **Bubbler System**

A bubbler type system typically applies water at a very fast rate, and is considered a high-flow type system. For that reason, the typical runtime of a bubbler system is only a few minutes. The bubbler is a small component that is attached to the tip of a riser.

Since trees, shrubs, and palms have deeper roots compared to groundcovers and lawn, it is better to irrigate deeply to promote deep root development and good establishment.

A bubbler located a few feet away from the trunk will do just that. It is also common to see a bubbler encased in a large diameter pipe, with the pipe going down one to two feet to promote an even deeper root system.

## **Drip Valve Assembly**

A drip valve assembly is made up of three components—the valve, a filter, and a pressure regulator. For proper operation, all three components need to be present.



**Filter and Pressure Regulator**

## **Filter**

The filter prevents debris from clogging the small orifice of the emitters. A 150 to 200-mesh filter should be enough to filter out any sediment.

*Look for rust and grit in the tank of our toilet to get an idea of how much sediment may be going through your system.*

## **Pressure Regulator**

The pressure regulator must reduce the 30 pounds per square inch (psi). If the pressure is not reduced, emitters may pop out of the line. If high pressure persists, you may find unequal or disproportional watering along the drip line (each emitter will discharge different amounts of water).

# ROOT ZONE DRIP IRRIGATION

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***1/2" Poly Pipe & 1/4" Spaghetti Tubing***

## **Polyethylene Tubing**

Polyethylene (PE) tubing with 1/2" diameter is standard, while 1/4" tubing (spaghetti) is also available. Both sizes of tubing are flexible and easy to cut and assemble, requiring no glue or threaded connections.

Keep in mind that 1/2" tubing is sturdier and therefore less maintenance intensive, but 1/4" tubing is easier to hide from view for container or potted plants. For optimum performance limit the length of run on 1/4" spaghetti tubing to 7 feet.



***Drip Emitters 0.5gph, 1gph, and 2gph***

## **Drip Emitters**

Emitters operate in the 1/2 - 2 gallon per hour (gph) range, and they all apply water directly to the soil without spraying to the air. Emitters on a drip system are ideal for single rooted shrubs and trees.

Make sure that the emitters you select will provide the correct amount of water to the plants served by your system. Remember that flows range from half to two gallons per hour. Many manufacturers color-code their emitters for ease of identification.

# FLOW AND PRESSURE

Installing an irrigation system requires at least basic knowledge of water flow and pressure. Flow is the amount of water delivered from the water source to the emission device (e.g. sprinkler) and is rated in gallons per minute. Pressure is the force that pushes that water. Pressure is rated in pounds of pressure per square inch. It is important to know both of these characteristics in order to design an efficient irrigation system. Why? All irrigation system components are rated according to both PSI and GPM.

## Water Flow—Gallons per Minute

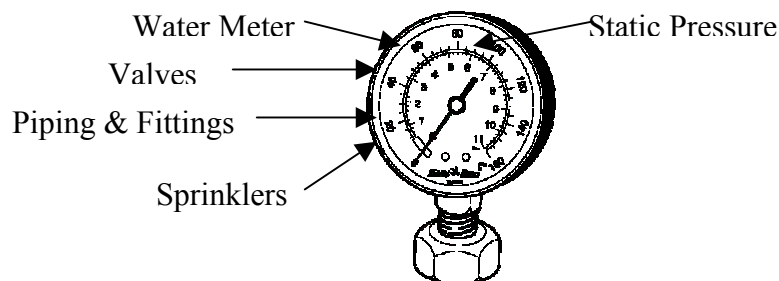
One simple way to figure out the flow available for your irrigation system is to conduct a bucket test. Turn on a faucet/hose bib completely and place a **five-gallon** bucket or container under it. Time how long it takes to fill up the bucket entirely and then use the table below. It is best to perform this test at the point of connection for the future irrigation system. The chart below will help you translate this data into usable information.

Run Time	GPM	Run Time	GPM
60 sec	5	30 sec	10
50 sec	5	20 sec	15
40 sec	7.5	10 sec	30

The available flow will determine the maximum number of sprinkler heads one valve can operate. For example, if a particular sprinkler has a flow of 3GPM, and you determine that the flow near the point of connection is 10GPM, the maximum number of sprinklers in one valve is then three with a total flow of 9GPM (under the available flow). Flow will also help in sizing your pipe correctly, which will be covered later in this booklet.

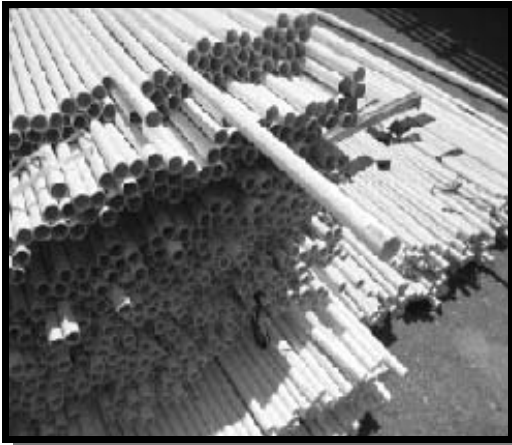
## Water Pressure—PSI

Place a pressure gauge with a female hose adapter to a garden hose faucet and turn on the faucet to take a pressure reading. This will indicate the maximum pressure available to work with. Note that the pressure reading indicates the highest potential pressure, but that there may be pressure loss due to factors such as old corroded pipes, long main lines, twists and turns, and the size of the pipe. The graphic below explains this concept.



As you can see, the pressure or force available to push the water is distributed among various places and components. At the end, the sprinkler is left with only the operating pressure, which many times may be as low as half of the starting pressure.

# IRRIGATION PIPE - PVC



*PVC pipe is available in different sizes including half inch, three quarter inch, one inch, and larger sizes.*

PVC pipe is the most common piping material for irrigation systems. PVC pipe is rated according to the burst pressure, or the maximum safe pressure of the pipe, which is related to the thickness of the pipe. The suggested pipe to use for residential systems is class 200 and/or schedule 40.

**Schedule 40 PVC** has a thick wall, which makes it safe and durable, but also a little more expensive (a few dollars). Schedule 40 should always be used for the irrigation system main line.

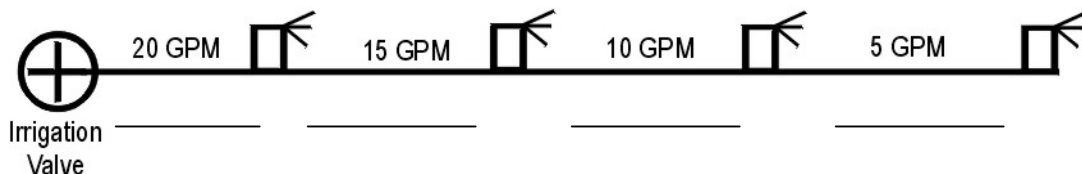
**Class 200 PVC** has a thinner wall, and may be used for lateral pipes in the irrigation system. It doesn't withstand as much pressure as the schedule 40, but it is a little less expensive.

**The Right Size Pipe**—What size pipe do you need? A pipe should always be sized according to the amount of water going through it. You are already familiar with flow and gallons per minute. Well, every kind of pipe and each particular size have a maximum flow it can carry. The problems come when we try to push too much water into a small size pipe. A lot of force is lost in trying to do that. The tables below will help you figure out the size of pipe you need for each segment of pipe in your system.

Schedule 40	
Pipe Size	Maximum flow in Gallons per Minute
¾ inch	8 GPM
1 inch	12 GPM
1 – ¼ inch	20 GPM
1 – ½ inch	30 GPM

Schedule 200 P	
Pipe Size	Maximum flow in Gallons per Minute
¾ inch	8 GPM
1 inch	12 GPM
1 – ¼ inch	20 GPM
1 – ½ inch	30 GPM

Each sprinkler applying  
5 gallons per minute



What size of Class 200 pipe should be used for each segment of this lateral?

There are four sprinklers requiring 5 GPM each from the supply line, assuming there's enough flow, the total flow requested is 20 GPM. When the valve opens it sends all 20 GPM down the first segment of pipe, but notice that 5 GPM leave the first sprinkler and that the flow through the second segment is now less. This is an example of where different size pipes are needed to carry different amounts of water.



# A GOOD SYSTEM - UNIFORMITY

By now you're familiar with the components that make up a typical irrigation system, but now it's time to talk about the performance of the system. ***In a good irrigation system the water is being applied evenly throughout the area being irrigated.*** In the landscape industry this is called distribution uniformity. Uniformity is never perfect; not even rain is 100% uniform, but a high level of uniformity should always be strived for. How is good uniformity achieved? To make sure a system has good uniformity the designer and installer must consider the **key points** described in this section. These key points also apply to existing systems.

• REPAIR BROKEN SPRINKLERS	• LOW PRESSURE
• HEAD TO HEAD COVERAGE	• TOO MUCH PRESSURE
• TILTED SPRINKLER HEADS	• MIXED SPRINKLER HEADS
• AVOID PLANT INTERFERENCE	• HORIZONTAL ANGLE AND RADIUS

**Repair Broken Sprinklers** — There are many ways a sprinkler can be damaged. The most common damage is caused by garden equipment. It is important to repair broken sprinklers quickly and to replace broken sprinkler heads with the appropriate models. It's very common to see broken sprinklers replaced with the incorrect equipment making the uniformity of the irrigation system suffer. It is also common to see broken sprinklers left unfixed for months, which accounts for hundreds or even thousands of gallons of water to be wasted.

**Head-to-Head Coverage** — The stream or spray of one sprinkler head must always reach the head of the adjacent sprinkler. This is especially true of lawn areas. A sprinkler head, almost always, provides much less water at the end of the stream or spray trajectory. For example, if a sprinkler is to throw 15 feet, the last few feet will provide much less water. To compensate for that, it is strongly recommended that sprinklers be at (head-to-head) coverage. This is especially important in windy areas where the spray and stream trajectory can be affected. Sprinklers heads should be spaced according to their radius.



**Tilted Sprinkler Heads**— Tilted sprinkler heads affect uniformity in that they alter the trajectory (angle of discharge), and radius (distance) of the sprinkler. Water is not going to get to where it needs to be. Unless a sprinkler head is watering a slope, it should always be positioned vertically, if the terrain is relatively flat. Ensuring proper trajectory and radius is important, considering that sprinklers are tested in the vertical position by manufacturers, and that is how watering and precipitation data are derived.

*To avoid sprinkler tilt, add sand to the base of the sprinkler. The sand will form a more stable and compact base for the sprinkler.*

# A GOOD SYSTEM - UNIFORMITY

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**Avoid Plant Interference** — Plant interference is also another common problem that affects uniformity. Interference refers to anything disrupting the normal spray pattern or stream of a sprinkler. This can be grass, trees, shrubs, hardscape, as well as a sprinkler head that has sunken below the soil level.

A good landscape design, irrigation installation and proper landscape maintenance should ensure that your sprinklers would always spray out in their intended pattern. A higher pop-up sprinkler can help; installing a 4" or 6" pop-up instead of 2" in lawn and using high risers in shrub planters will do the job. Just trimming a plant can sometimes solve the problem. Look for this problem in your existing system or make sure you avoid it when installing your new irrigation system.

**Low Pressure Problem** — Low pressure is a common problem that typically results in the characteristic doughnuts of dead grass with a small circle of green grass near the sprinkler. Low pressure is easily identified by a visual inspection. Look for a reduction in the radius of throw and large water droplets.

Low pressure may be caused by one or more of the following:

1. The flow control stem on the valve is choked down too far and is nearly closed (it needs to be opened)
2. A pressure regulator is choked too far down (needs to be set at the correct pressure)
3. There may be too many sprinklers running at the same time (add another valve)
4. And finally, the nozzle sizes installed require more flow than the source can provide (reduce nozzle size)



**High Pressure - Too Much Pressure** — High pressure can result in erratic plant decline. This is because of the characteristic misting caused by too much pressure, where water droplets are so small that they're carried away before reaching the ground. The easiest way to remedy this problem is to install an inline pressure regulator after the automatic valve. This problem is more common on sprayhead sprinklers, due to the fact that they operate at lower pressure (nearly half the pressure) compared to rotors.

**Mixed Sprinkler Heads** — Mixing rotor type sprinklers and spray heads on the same circuit is a poor, but unfortunately, common practice. As mentioned before, these are different types of sprinklers that operate differently and provide different amounts of water over a given area. Plant material watered by the mixed equipment will either be over or under-watered because of the different application rates. Rotor type sprinklers apply water at a much slower rate compared to sprayheads. This is why rotor valves typically run for a longer period of time.

# A GOOD SYSTEM - UNIFORMITY

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**HORIZONTAL ANGLE AND RADIUS—** The horizontal angle refers to the direction in which a sprinkler sprays or discharges its stream. The radius is how far the sprinkler applies the water. The horizontal angle is given one of the following categories: full circle 360°, half circle 180°, or quarter circle 90°.

Also available are adjustable angle types. The horizontal angle and the radius often become unaligned, and that is when we see sprinklers watering the sidewalks and driveways instead of the garden. These adjustments can be done easily on both sprayheads and rotors, but you do need to become familiar with your sprinkler heads. Once again a simple visual inspection will identify the above-mentioned problems.





There are many more things to learn about irrigation systems and landscape watering, but we hope that this booklet gets you going in the right direction. Remember that watering is one of the most important aspects of gardening, and understanding the irrigation system is another step toward a successful garden. And also remember that...


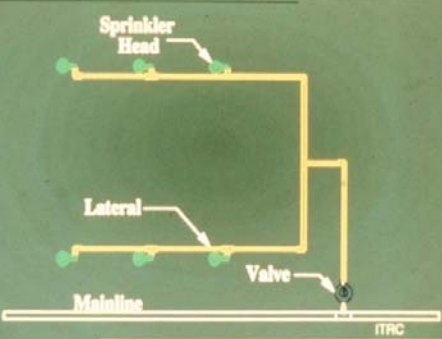
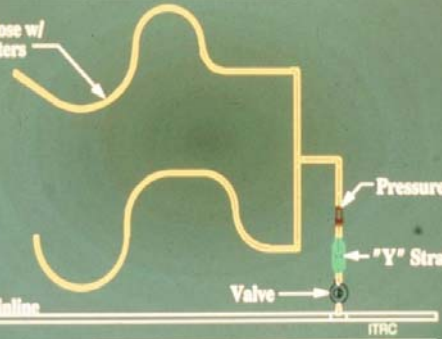

***“AN IRRIGATION SYSTEM IS A CONTROLLED LEAK”***




<div>Residential Irrigation Systems</div> <div><div><div>Funded by:</div><div><div></div><div><div>MWD</div><div>METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA</div></div></div><div><div>Developed by Don Schultz</div></div></div></div> <div></div> <div><div></div><div></div><div></div><div></div><div></div><div></div></div>										
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<div>More People, Increased Demand</div> <div><div><table><caption>Population Growth Data (Estimated)</caption><thead><tr><th>Year</th><th>Population (Stick Figures)</th></tr></thead><tbody><tr><td>1970</td><td>~10</td></tr><tr><td>1980</td><td>~20</td></tr><tr><td>1990</td><td>~30</td></tr><tr><td>2000</td><td>~40</td></tr></tbody></table></div></div> <div></div> <div><div></div><div></div><div></div><div></div><div></div><div></div></div>	Year	Population (Stick Figures)	1970	~10	1980	~20	1990	~30	2000	~40
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<p>Landscapes look better with good water management</p>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
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<p><b>Gardeners and Landscape Maintenance Personnel play a key role</b></p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>SYSTEM HARDWARE</b></p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>DRIP SYSTEM</b></p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
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<div>Overhead Sprinklers</div> <div><ul style="list-style-type: none"><li>• Turf Areas</li><li>• Slopes or Planter Beds that include ground cover</li></ul></div>		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div>
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<p style="text-align: center;"><b>Bubblers</b></p> <ul style="list-style-type: none"> <li>• To water individual shrubs and trees</li> <li>• Planters without ground cover (flat areas only)</li> <li>• High flow capability</li> </ul>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
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<p><b>Drip Irrigation</b></p> <ul style="list-style-type: none"> <li>• To water individual shrubs and trees</li> <li>• Planters without ground cover (flat areas or slopes)</li> <li>• Very useful when there are flow limitations</li> </ul>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
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<p><b>Valve Placement</b></p> <ul style="list-style-type: none"> <li>• Put valves together in a manifold</li> <li>• Put each valve in the area it waters</li> <li>• Put valves near the control clock (less amount of valve wire)</li> <li>• Put valves near the water connection (less main line)</li> </ul>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>



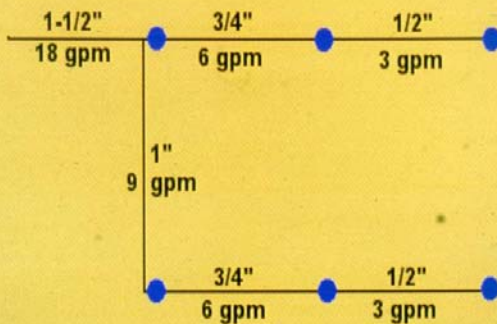
## Pipe Size (Diameter)

- Size of pipe is based on the flow through that section of pipe
- Add the total flow of all sprinklers supplied by each section of pipe (from sprinkler manufacturer)
- Check chart in handbook to determine pipe size

## Pipe Wall Thickness


- Main Line – Schedule 40
- Lateral Line – Class 200

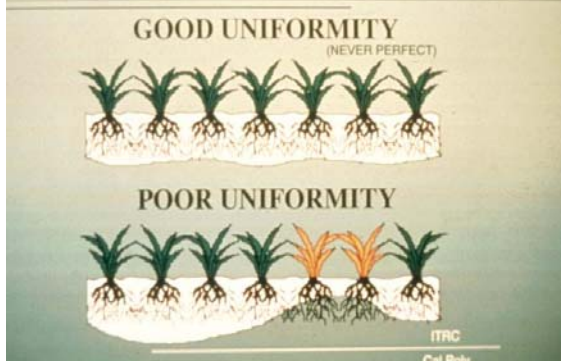

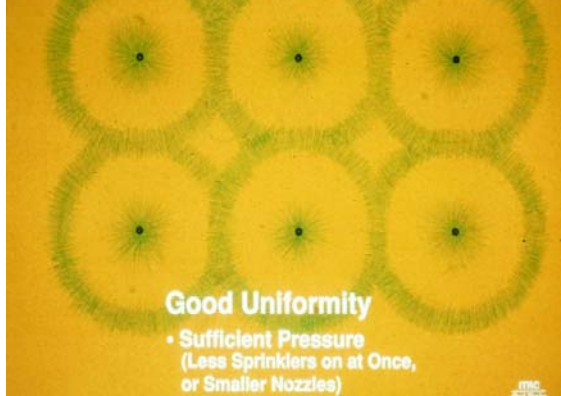
Schedule 40 pipe



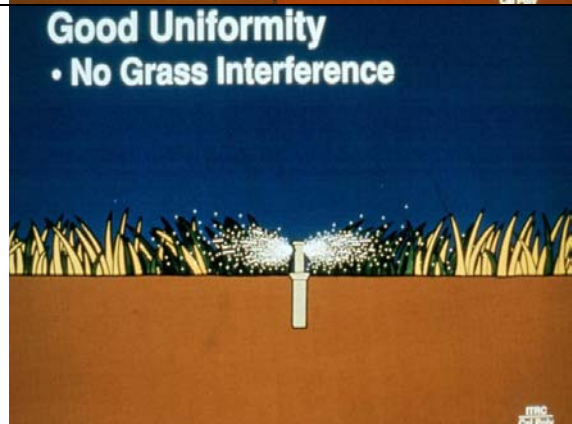



## Pipe Sizing Chart




Schedule 40		Class 200	
Size	Max Flow (gph)	Size	Max Flow (gph)
1/2"	4	1/2"	10
3/4"	8	3/4"	17
1"	13	1"	35
1 1/2"	30	1 1/2"	55
2"	50	2"	




<div>Uniformity</div>		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div>
<div><div>Uniformity</div><div><ul style="list-style-type: none"><li>• Dry spots show up where enough water doesn't reach</li></ul></div></div>		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div>
<div></div>		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div>
<div><div>Distribution Uniformity</div><div><ul style="list-style-type: none"><li>• How evenly applied</li><li>• Wet vs. Dry</li></ul></div></div>		<div></div> <div></div> <div></div> <div></div> <div></div> <div></div>

<p><b>Distribution Uniformity(DU)</b></p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>How to Get Good Uniformity</b></p>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
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<p><b>Good Uniformity Equal Sprinkler Spacings</b></p>  <p><b>No</b> <b>Yes</b></p>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>Good Uniformity</b> • Adjustment of horizontal Angle</p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>Uniformity</b></p> <ul style="list-style-type: none"> <li>• Repair broken sprinklers quickly with the same model of sprinkler as before</li> </ul>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

<p><b>The Replacement Must Be the Same Nozzle Size</b></p> 		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
 <p><b>Good Uniformity</b> • Don't Mix Sprinkler Types</p>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p><b>Major Points</b></p> <ul style="list-style-type: none"> <li>• Good Uniformity</li> <li>• Soil Moisture and Timing</li> </ul>		<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>